

## Claims

1. Method of forming a corner region bounded on three sides from a flat plate, in particular a sheet metal plate, in which the side edges adjacent to a corner region are folded back by a predeterminable height across a major part of their longitudinal extension parallel with a side edge of the plate and shaped in the region in which the corner is to be formed running from the folded-down side walls to the plane of a flat plate part in a three-dimensionally curved transition region, wherein the pre-formed component is pressed in the curved transition region, by means of at least one roller system overlapping the corner region between the side walls, against a tool having a predeterminable, three-dimensional external shape of a corner and the corner is shaped by forming the material, characterised in that the side walls (8) in the transition region and in the corner region (10) are formed across their entire height (206) so as to abut against the shaping surfaces (36) of the tool (16) immediately adjacent to the corner region (10) to be produced.
2. Method of forming a corner region from a flat plate, in particular sheet metal plate, in which the side edges are folded down and a three-dimensionally curved transition region is formed in the corner region between the side edges, the latter being formed by material deformation to produce the desired shape of the corner and having a projection in the corner region, characterised in that the component (2) is placed with the free end faces (193) of at least two side walls (8) adjacent to the projection (194) and subtending a corner region (10) between them, on at least one bearing element (205) forming a guide surface (204) and the region of the projection (194) standing out beyond the guide surface (204) in the direction away from the flat plate part (6) is separated by means of cutting elements (38, 157, 158) displaceable relative to one another, the cutting edges (163, 164) of which extend in the guide surface (204).
3. Method of forming a corner region from a flat plate, in particular a sheet metal plate, wherein the side edges adjacent to the corner are folded down by a predeterminable height across a major part of their longitudinal extension parallel with a side edge of a flat plate part and shaped in the region in which the corner is to be formed running from the folded-down side edge to the plane of a flat plate part in a three-dimensionally curved transition region, wherein the pre-formed blank with the curved transition region is placed against a tool having a predetermined three-dimensional external shape of a corner region so that the transition region is located in the

region of the three-dimensional external shape of a corner region and the side edges lie against side faces of the tool, after which the component is clamped between the tool and a height-adjustable clamping plate, characterised in that, prior to clamping the component (2), the front edges (181) of the clamping plate (175) co-operating with the side walls (8) forming the corner region (10) are placed between a position flush with the shaping surfaces (36) of the tool (16) or a position projecting beyond these shaping surfaces (36) substantially by the thickness (179) of the component (2).

4. Method of forming a corner region from a flat plate, in particular a sheet metal plate, wherein the side edges adjacent to the corner are folded down by a predeterminable height across a major part of their longitudinal extension parallel with a side edge of a flat plate part and shaped in the region in which the corner is to be formed running from the folded-down side walls to the plane of a flat plate part in a three-dimensionally curved transition region, after which the pre-formed blank with the curved transition region is placed against a tool having a predetermined three-dimensional external shape of a corner region so that the transition region is located in the region of the three-dimensional external shape of a corner region and the side walls lie against side faces of the tool and is pressed by means of at least one roller system overlapping the corner region between the side walls against a tool having a predeterminable three-dimensional external shape of a corner and the corner is shaped by forming the material, characterised in that the tool (16) is rotatably mounted on a sliding element (127), being fixed in different positions relative thereto, and in that the sliding element (127) is adjusted in a plane parallel with the flat plate part (6) of the component (2) in a direction indicated by double arrow (149) running at  $45^\circ$  relative to the axis of symmetry (135) of the roller system (42) and in a direction indicated by double arrow (150) perpendicular thereto in order to set a uniform distance (134) between the cylinder contours (132) of the roller system (42) and the shaping surfaces (36).

5. Method as claimed in one or more of claims 1 to 4, characterised in that the side walls (8) in the transition region and in the corner region (10) of the component (2) are adapted to the external shape of the tool (16) in the region of the shaping surfaces (36) by means of a rolling process.

6. Method as claimed in one or more of claims 1 to 5, characterised in that a distance (134)

perpendicular to the shaping surfaces (36) of the tool (16) between the shaping surfaces (36) and a cylinder contour (132) of the roller system (42) is the same as or slightly smaller than a thickness of the component (2) to be produced.

7. Method as claimed in one of claims 1 to 6, characterised in that the tool (16), the clamping device (62) or the clamping plate (175) thereof can be adjusted in terms of their distance (134) from the cylinder contour (132) of the roller system (42) running perpendicular to the shaping surfaces (36) of the tool (16).

8. Method as claimed in one or more of claims 1 to 7, characterised in that the cylinder contours (132) of the roller system (42) can be adjusted in terms of their distance running perpendicular to the side face of the tool (16).

9. Method as claimed in one or more of claims 1 to 8, characterised in that a roll (125) of the roller system (42) is rolled across the entire height of the side walls (8) and a projection (194) in the corner region (10) of the component (2) to be produced.

10. Method as claimed in one or more of claims 1 to 9, characterised in that the position of end faces of the side walls (8) of the component (2) when placed against the tool (16) or a corresponding clamping device is preferably without contact and the projection (194) disposed between the latter in the corner region (10) of the component (2) is separated by the action of a beam of energy.

11. Method as claimed in one or more of claims 1 to 10, characterised in that the bearing element (205) is fixed and the cutting elements (157, 158) are displaceable relative to the bearing element (205) and perpendicular to the side walls (8) of the component (2) to be produced.

12. Method as claimed in one or more of claims 1 to 11, characterised in that bearing elements (205) for the component (2) are provided on one of the two, in particular the displaceable (158) cutting elements.

13. Method as claimed in one or more of claims 1 to 12, characterised in that a guide surface

(204) extends horizontally.

14. Method as claimed in one or more of claims 1 to 13, characterised in that the guide surface (204) extends vertically.

15. Method as claimed in one or more of claims 1 to 14, characterised in that a rotating cutting element is used, which is displaced parallel with the guide surface (204) transversely to the projection (194).

16. Method as claimed in one of claims 1 to 15, characterised in that the clamping plate (175) is displaceable relative to the tool (16) in a direction running towards the shaping surfaces (36) of the tool (16).

17. Method as claimed in one or more of claims 1 to 16, characterised in that the clamping plate (175) is adjusted together with a safety door (109) delimiting the working region, in particular is adjusted in height.

18. Method as claimed in one or more of claims 1 to 17, characterised in that the safety door (109) and the tool (16) are adjustable in a direction running perpendicular to the shaping surfaces (36) of the tool (16).

19. Method as claimed in one or more of claims 1 to 18, characterised in that the inclined surfaces adjacent to the front edges (181) of the clamping plate (175) are disposed at a greater distance from a plane parallel with the shaping surfaces (36) of the tool (16) and containing the front edge (181), the greater the distance from the tool (16).

20. Method as claimed in one or more of claims 1 to 19, characterised in that each shaping surface (36) of the tool (16) co-operates with a separate, independently displaceable clamping plate (175).

21. Method as claimed in one or more of claims 1 to 20, characterised in that the clamping plate (175) is applied against the tool (16) by a clamping element (176), which is independent of

the adjusting mechanism(112) of the safety door (109), exerting a compression force in the direction of the tool (16).

22. Method as claimed in one or more of claims 1 to 21, characterised in that the clamping plate (175) is made up of several different plates.

23. Method as claimed in one or more of claims 1 to 22, characterised in that for each corner region of the tool (16), an associated roll (125) is provided on the roller system (42) and/or a clamping plate (175).

24. Method as claimed in one or more of claims 1 to 23, characterised in that the quantity of lubricant is increased for a roller system (42) with a larger cylinder surface and decreased for a smaller cylinder surface.

25. Method as claimed in one or more of claims 1 to 24, characterised in that the lubricant is applied to the inclined surface, preferably the front edge (181) of the clamping plate (175) from where it is directed by force of gravity into the region of the side walls (8) and the corner region (10) of the component (2) to be shaped.

26. Method of forming a corner region from a flat plate, in particular a sheet metal plate, in which the side edges adjacent to the corner region are folded back by a predeterminable height across a major part of their longitudinal extension parallel with a side edge of a flat plate part and shaped in the region in which the corner is to be formed from the folded-down side edge to the plane of the flat plate part in a three-dimensionally curved transition region, wherein the pre-formed blank with the curved transition region is placed against a tool having a predetermined three-dimensional external shape of a corner region so that the transition region is located in the region of the three-dimensional external shape of a corner region with the side walls lying against side faces of the tool, and is pressed against a tool having a predeterminable three-dimensional external shape of a corner by means of a roller system spanning the corner region between the side walls and the corner is shaped by forming the material, characterised in that a roll (125) of the roller system (42) is rolled along the side walls (8) and the projection (194) and a lubricant is delivered to the contact region between roll (125) and the component (2), the quantity of which is

metered so that the coefficient of friction between the roll (125) and the component (2) is above the sliding friction.

27. Method as claimed in one or more of claims 1 to 26, characterised in that the sides and the transition region of the component (2) are pressed against the shaping surfaces (36) of the tool (16) by means of the roller system (42) for shaping purposes and flat-rolled, after which the component (2) is removed from the tool (16) and placed with the free end faces (139) of at least two side walls (8) on the bearing element (250), and the projection (194) projecting beyond the guide surface (204) is cut off by means of cutting elements (157, 158) displaceable relative to one another in a direction parallel with the flat plate part (6).

28. System for forming a corner region bounded on three sides on a component from a flat sheet by means of a tool, the corner and peripheral design between a top face and the side faces thereof being adapted to produce the three-dimensional shape of the corner regions to be produced, having a clamping device for clamping the component between the latter and the top face of the tool and, lying opposite the corner region to be produced on the component, having a roller system with a roll, displaceable together in a direction substantially perpendicular to the top face of the tool across a height of the side faces relative to the workpiece, characterised in that a height (212) of the shaping surfaces (36) of the tool (16) is the same as or slightly larger than a height (206) of the side walls (8) of the component (2) plus a height (213) of the projection (194) in the corner region (10).

29. System for forming a corner region bounded on three sides on a component from a flat sheet by means of a tool, the corner and peripheral design between a top face and the side faces thereof being adapted to produce the three-dimensional shape of the corner regions to be produced, having a clamping device for clamping the component between the latter and the top face of the tool and, lying opposite the corner region to be produced on the component, having a roller system with a roll, displaceable together in a direction substantially perpendicular to the top face of the tool across a height of the side faces relative to the workpiece, and having a cutting device, preferably with a fixed and a displaceable cutting element, characterised in that a bearing element (205) is provided adjacent to the tool (16), preferably in an independent machine frame (104) separate from the cutting plate (14) for holding the tool (16), which has at least one

guide surface (204), adjacent to the projection (194), for receiving free end faces (193) of at least two side walls (8) subtending a corner region (10) between them, and in that cutting elements (157, 158) displaceable relative to one another, are assigned to the corner region projecting beyond the guide surface (204) by a projection (194) of the corner region (10), the cutting edges (163, 164) of which are disposed in a plane containing the guide surface (204).

30. System for forming a corner region bounded on three sides on a component from a flat sheet by means of a tool, the corner and peripheral design between a top face and the side faces thereof being adapted to produce the three-dimensional shape of the corner regions to be produced, having a clamping device for clamping the component between the latter and the top face of the tool and, lying opposite the corner region to be produced on the component, having a roller system with a roll, displaceable together in a direction substantially perpendicular to the top face of the tool across a height of the side faces relative to the workpiece, characterised in that the front edges (181) of the clamping plate (175) of the clamping device (62) co-operating with the side walls (8) forming the corner region (10) are flush with the shaping surfaces (36) of the tool (16) or project beyond it in the direction of the roller system (42) by a dimension which is slightly smaller than the thickness (179) of the plate part (6).

31. System for forming a corner region bounded on three sides on a component from a flat sheet by means of a tool, the corner and peripheral design between a top face and the side faces thereof being adapted to produce the three-dimensional shape of the corner regions to be produced, having a clamping device for clamping the component between the latter and the top face of the tool and, lying opposite the corner region to be produced on the component, having a roller system with a roll, displaceable together in a direction substantially perpendicular to the top face of the tool across a height of the side faces relative to the workpiece, characterised in that the roller system (42) has a roll (125), which is mounted so as to be displaceable in a straight line in a plane at a tangent to the corner region (10), at an angle of  $45^\circ$  to the shaping surfaces (36) bordering the corner region (10) and parallel therewith and in that a delivery device for lubricant co-operates with the roll (125) or the component (2) placed on the tool (16) and/or the clamping plate (175) of the clamping device (62) and the lubricant-delivery device is connected via a metering system to a control device for delivering quantities of lubricant.

32. System for forming a corner region bounded on three sides on a component from a flat sheet by means of a tool, the corner and peripheral design between a top face and the side faces thereof being adapted to produce the three-dimensional shape of the corner regions to be produced, having a clamping device for clamping the component between the latter and the top face of the tool and, lying opposite the corner region to be produced on the component, having a roller system with a roll, displaceable together in a direction substantially perpendicular to the top face of the tool across a height of the side faces relative to the workpiece, characterised in that the roller system (42) has a roll (125), which is rotatably mounted in a bearing (207) fixed in a mounting frame (208) and in that a support frame (209) is used with guide elements (118) for replaceably inserting in a guide device (211) a guide housing (210) which is displaceable relative to the tool (16) by means of a drive system (126) and in that a replacement device (121) receiving the guide device (211) has elements (122) for clamping the support frame (209) in the correct position in the guide housing (210).
33. Corner-shaping device with an adjusting mechanism, adapted to a box-shaped component, having a substantially multi-cornered, flat tool fixed to a cutting plate, which is supported by a frame, the tool having substantially polygonal horizontal top and bottom faces and side faces joining the top and bottom faces, the tool additionally having a shaping region formed by the top face at a corner of the tool and two side faces co-operating with said top face, wherein the shaping region forms the corner region of the box-shaped component, and having a roller system of a design comprising circular-based cone parts substantially in mirror image displaceable along the two side faces constituting the shaping region in a corner of the tool, with two thrust faces for producing the corner region of the box-shaped component by forming an excess piece of the box-shaped component in one of its corners so that the excess piece bears directly against the two side faces when the roller system is displaced along said two side faces, characterised in that the system has an adjusting mechanism (26) for setting a predeterminable distance in a direction perpendicular to the side face of the tool (16) between the shaping surfaces (36) and the cylinder contours (132) of the roller system (42) by means of which the tool (16) and the roller system (42) are displaceable relative to one another in a direction perpendicular to the shaping surfaces (36).
34. Corner-shaping device as claimed in claim 33, characterised in that the adjusting mecha-



nism (26) has a manually adjustable threaded spindle for adjusting the tool (16) at a forward or retracted distance.

35. Corner-shaping device as claimed in claim 33, characterised in that the adjusting mechanism (26) has a conical part linearly displaceable by the drive system (126) for setting the tool (16) at a forward or retracted distance.

36. Corner-shaping device as claimed in claim 33, characterised in that the adjusting mechanism (26) has a wedge-shaped part and an adjustable part which slides on an inclined surface of the wedge-shaped part and a motion transmitting device for displacing the adjustable part.

37. Corner-shaping device as claimed in claim 33, characterised in that a shaping section (96) is formed by a top face (40) on a corner of the tool (16) and two side faces (34) in the region of this top face (30) and the shaping sections (96) in the different corners of the tool (16) are of different dimensions.

38. Corner-shaping device as claimed in one or more of the preceding claims, characterised in that the roll (125) and the clamping device (62) constitute a jointly displaceable clamping and shaping device operated by a common drive, e.g. actuating cylinder (224) in the guide device (107).

39. Corner-shaping device as claimed in one or more of the preceding claims, characterised in that the roll (125) and the clamping device (62) are disposed in a cartridge (226), which is retained in a guide carriage (221) so that it can be rapidly replaced.

40. Corner-shaping device as claimed in one or more of the preceding claims, characterised in that the clamping device (62) has a clamping plate (232) which is mounted so as to be displaced via guide posts (233) in the cartridge (226) against the action of a spring arrangement (237).